

Constraining Early Planetary Differentiation: The Link Between Chondrites and Achondrites Revealed From the Study of Aubrite Meteorites

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Meteorites fall into two broad categories, chondrites, which are almost pristine pieces of the early solar system before planets formed, and achondrites, which come from differentiated bodies; *i.e.*, planets or asteroids with layers of core, mantle, and crust. One type of meteorite, called aubrite or enstatite achondrite, is fascinating because it may represent a link between chondrites and achondrites. Moreover, enstatite achondrites formed very early in the solar system history, and therefore provide insight into early planetary formation.

The focus of our study was to determine the quantity of platinum group elements (PGE) in the abundant metal and sulfides of several well-known enstatite achondrites. Our sample aliquots were first characterized in the electron microprobe (EMP) laboratory of the ARES Directorate at JSC (figure 1), while the PGE were measured at Florida State University by laser inductively coupled plasma mass spectrometry (ICPMS). Our PGE measurements are consistent with samples originating from different parent bodies, and with each comes a complex history of melt extraction and differentiation, asteroid breakup and re-accretion, and infiltration by impact melts. However, the PGE patterns measured in the enstatite achondrites are similar to those of enstatite chondrites (figure 2), favoring a common origin for the two types of meteorites; *i.e.*, the origin of enstatite achondrites could be from the differentiation of enstatite chondrites.

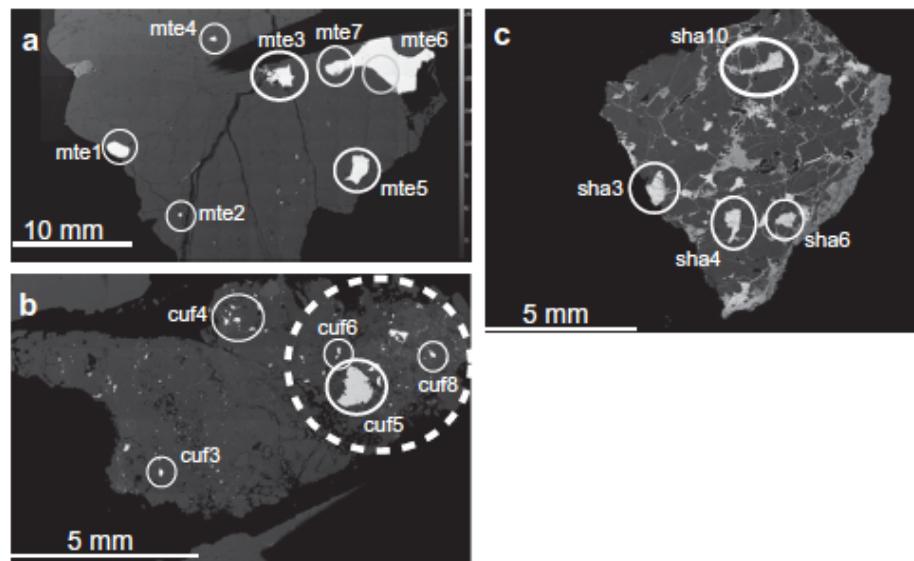


Figure 1.– Electron back-scattered maps of the aubrite thin sections – (a) Mt. Egerton, (b) Cumberland, and (c) Shallowater – showing the area targeted for PGE analysis. The brightest phases are metals and sulfides.

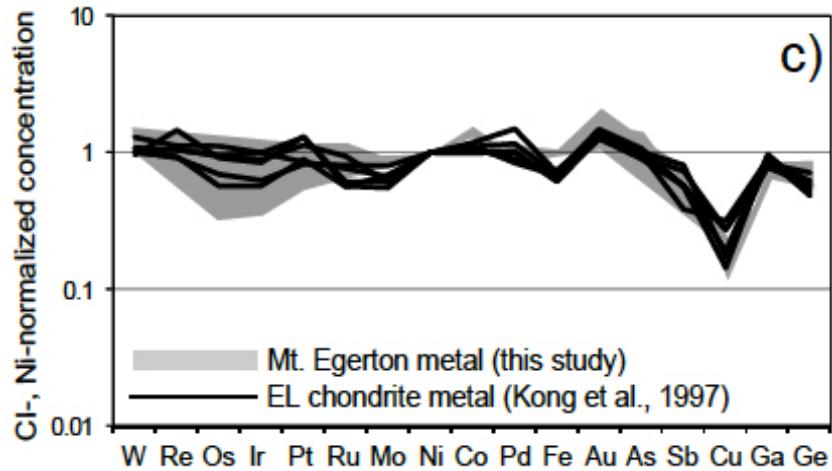


Figure 2.– PGE contents in an enstatite achondrite (Mt. Egerton in black) are similar to those of enstatite achondrites (EL in grey).

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Probing Asteroid (4) Vesta, Part 1: Dawn Mission Science

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A long, long time ago in a state far, far away, a young geochemistry graduate student began his research career studying a clan of igneous meteorites that were thought to have come from the asteroid (4) Vesta. Little did he know that NASA would launch a spacecraft mission to that asteroid in his “greybeard” years, or that he would be a member of the mission science team. The Dawn spacecraft was launched in September 2007 and, using the turtle’s “slow and steady wins the race” methodology, arrived at Vesta in July 2011. The spacecraft spent 14 months in a series of orbits of different altitudes, studying the surface with its framing camera (FC), visible and infrared mapping spectrometer (VIR), and gamma ray and neutron detector (GRaND), and probing the interior through gravity measurements. Vesta is located in the asteroid belt between Mars and Jupiter and is the second largest asteroid, with a mean radius of 263 km.